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IZA World of Labor
Evidence-based policy making

The changing nature of jobs in Central and Eastern Europe

Restructuring and upskilling prevents job polarization but may leave countries vulnerable to routine-biased technical change

ELEVATOR PITCH

Job polarization can pose serious problems for emerging economies that rely on worker reallocation from low-skilled to middle-skilled jobs to converge toward advanced economies. Evidence from Central and Eastern European (CEE) countries shows that structural change and education expansion can prevent polarization, as they enable a shift from manual to cognitive work and prevent the "hollowing out" of middle-skilled jobs. However, in CEE countries they have also led to a high routine cognitive content of jobs, which makes such jobs susceptible to automation and computerization in the future.

Decomposition of task content changes in the CEE

Note: Changes between 1998–2000 (for HR 2003–2005) and 2011–2013. Weighted (by employment) average for CZ, EE, HR, HU, LV, PL, RO, SI, and SK.

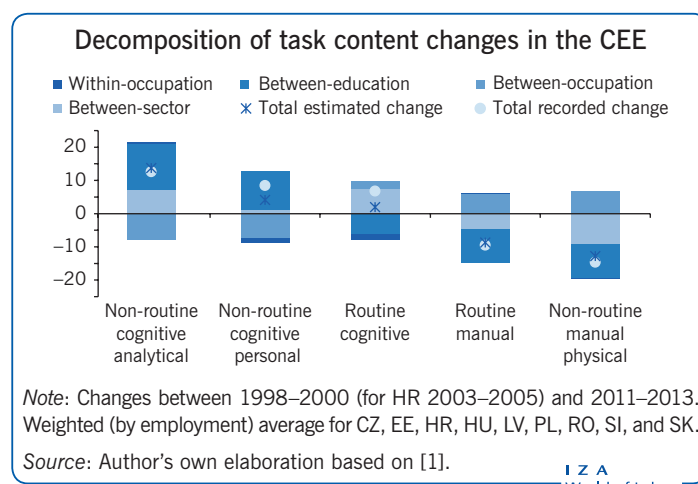*Source*: Author's own elaboration based on [1].

KEY FINDINGS

Pros

⊕ Analyzing the task content of jobs allows a better understanding of occupational changes.

⊕ In CEE, structural and educational changes align well with respect to occupational change.

⊕ Aggregate restructuring triggered a shift from manual to cognitive jobs.

⊕ Tertiary education expansion fueled the growth of non-routine cognitive work.

⊕ The shift to jobs requiring higher skills dominated over the decline of middle-skilled manual jobs and prevented job polarization.

Cons

⊖ The decline of manual work left some workers vulnerable to unemployment.

⊖ The routine cognitive content of jobs increased in CEE, contrary to the most advanced economies.

⊖ As the number of graduates rose, the routine cognitive component of their jobs also increased.

⊖ Routine cognitive jobs are vulnerable to routine-biased technological change.

⊖ Country-specific surveys are needed to further study the task contents of particular occupations around the world.

AUTHOR'S MAIN MESSAGE

Aggregate restructuring in CEE during the 1990s triggered a substantial shift from manual to cognitive work. The expansion of tertiary education aligned well with structural change and the non-routine cognitive content of jobs grew strongly. Job polarization, which is a concern for many advanced economies, did not occur, as the number of routine-intensive, middle-skilled jobs remained flat, and in many countries even increased. This, however, left the CEE countries vulnerable to routine-biased technical change. Policies in transition economies should therefore support further workforce upskilling and development of information and communication technology skills.

MOTIVATION

Structural change within economies is an inherent component of development that shifts the structure of labor demand and triggers occupational changes. Such changes have also recently been affected around the world by technological progress, which reduces demand for routine, codifiable tasks. In the most developed countries this has led to a hollowing-out of the middle-skilled jobs, referred to as job polarization. Polarization can pose even more serious problems in emerging economies because reallocation from low-skilled to middle-skilled jobs is a crucial means of increasing incomes, improving job quality and generating inclusive growth.

Since the 1990s, the transition economies of Central and Eastern Europe (CEE) have experienced rapid evolution in the structure of the economy and substantial educational change: an increase in tertiary education enrollment, and a decline in basic vocational education enrollment. Their experience provides an opportunity to better understand whether job polarization emerges during the transition of middle-income economies, and how the interplay of structural and educational change affects the task content of jobs. Such observations can provide valuable lessons for countries undergoing economic transition or significant structural change.

DISCUSSION OF PROS AND CONS

Tasks: What they are and how are they measured?

Tasks are not skills, though they are closely related. A task is a "a unit of work activity that produces output" [2]. However, workers need a body of skills to perform various tasks—for instance, an architect needs both high numeracy and mathematical skills to perform highly non-routine cognitive tasks. Thus, skills can be seen as the capability of workers to perform particular tasks. Researchers identify four major types of job tasks:

- *Non-routine cognitive tasks* are typical for high-skilled workers. They are often divided into *analytical* and *personal* subcategories. They require abstract thinking, creativity, problem-solving and extraordinary communication skills. Computers are found to be complementary to these tasks since they can improve the productivity of workers performing non-routine cognitive tasks. Managers, designers, engineers, and IT specialists are all occupations that are highly saturated with these tasks.

- *Routine cognitive tasks* are most often attributed to middle-skilled workers. Computers are substitutes for routine cognitive tasks. These tasks require the performance of explicit and repeatable sets of activities, which can therefore be easily coded using a computer. Clerks, sales workers, administrative occupations, and bank tellers are highly suffused with these tasks.

- *Routine manual tasks* are typical for middle- and low-skilled workers. Like routine cognitive tasks, they are highly "codifiable" and easily replaceable by automation. They are most often carried out by production workers such as assemblers and toolmakers.

- *Non-routine manual tasks* are common for low-skilled workers. They require situational adaptability, language and visual recognition, and social interactions. Occupations rich in non-routine manual tasks are, for instance, drivers, farmers, and mining and construction laborers. So far, these tasks are not replaceable by machines.

Each occupation consists of various proportions of the content of these four tasks. However, the intensities of particular task contents are highly variable across occupations. For example, non-routine manual tasks are most important for car drivers, but car drivers also perform non-routine cognitive personal and routine cognitive tasks with above-average intensity. The opposite is true for analytical and routine manual tasks.

The Occupational Information Network (O*NET) database is the most commonly used source of information on the task content of occupations. It has been collected in the US since 2003 and, so far, has covered approximately 1,000 occupations. The data include information on the importance and level of skills, work activities, and abilities required to perform particular jobs. The methodology of constructing five task content measures is outlined in [3]. Studies that utilize country-specific skills and occupational surveys in, for example, Canada, the Czech Republic, Italy, and the UK show that O*NET data can be credibly applied to other OECD and European countries [3], [4]. Usually, researchers combine O*NET data with country-specific labor force survey data to obtain the task content of jobs in particular countries. Because there is no objective unit of tasks, researchers usually present results as relative changes of particular tasks per worker.

Structural change, occupational change, and task content of jobs

Economic transition and convergence entail sectoral shifts. Since the 1990s, the CEE countries, especially those that have become EU member states, have experienced rapid structural change. Employment in agriculture declined, the number of industrial jobs decreased slightly, and the service sector grew across the region. Traditional branches of manufacturing, such as heavy industry and clothes production, for example, shrank, while new champions emerged (e.g. cosmetics and rubber in Poland, machinery and vehicles in the Czech Republic and Slovakia). The growth of the service sector in CEE largely encompassed sections related to business support or personal activities, which were both underdeveloped in the 1990s. Restructuring is related to factor reallocation, and particular types of activities require different kinds of inputs, which are sometimes quite specific to a given activity. This in turn influences the demand for particular types of labor and can trigger occupational changes. In transition economies, production techniques that already exist in the most developed countries can be rapidly adopted. As a result, structural and occupational changes can occur more quickly than in advanced economies, and thus pose more severe challenges for workers, firms, and policymakers.

Structural and occupational changes are intertwined with technological progress. This link has attracted a considerable amount of attention recently, especially in relation to automation, information and communication technology (ICT), and routine-biased technological change (RBTC) [5], [6]. RBTC increases demand for high-skilled workers who can perform non-routine cognitive work, both analytical and interpersonal that is, so far, not replaceable by machines and complementary to ICT and automation. This includes occupational groups such as managers, professionals, technicians, and associate professionals, as defined by the International Standard Classification of Occupations (ISCO). On the other hand, RBTC decreases demand for middle-skilled workers performing routine work, both manual and cognitive, which can be replaced by machines (e.g. clerical support workers, services and sales workers, craft and related trades workers, plant and

machine operators, and assemblers). RBTC does not substitute for non-routine manual work that is not yet prone to automation, and can be provided by humans relatively cheaply (e.g. janitors, drivers, waiting staff). However, the displacement of routine, middle-skilled jobs indirectly increases the supply of workers willing to take up low-skilled jobs, which are intensive in non-routine manual tasks. Studies on the US and Western Europe find that the input of routine manual and routine cognitive work has been declining since the 1980s, while the input of non-routine cognitive work rose within industries, occupations, and education groups [5], [7]. Other studies show that this process, in turn, led to job polarization (i.e. a declining share of middle-wage jobs/middle-skilled workers) and wage polarization (i.e. rising relative wages of high-skilled workers, and stagnating or declining wages of middle-skilled workers) [2], [6].

The sectoral dimension of routine-biased developments is important [2], [6]. Routine-intensive, middling occupations are often found in manufacturing and services, such as administrative and support activities, trade, and repairs. The growing, high-skilled and non-routine intensive occupations constitute the top jobs in most sectors, but are especially common in professional, financial, insurance, and real estate services. Non-routine manual interpersonal jobs are typical for simple services—e.g. accommodation and food. Manufacturing, transportation, and logistics, but also services (e.g. office and administrative support activities), have the highest shares of jobs that could be made redundant by automation and computerization over the next 10 to 20 years [8]. These are the sectors that emerging economies usually see growing, as has been the case in CEE since the 1990s. Therefore, the challenges of RBTC in emerging economies can be even more serious than in more mature economies.

Occupational change and RBTC are usually analyzed using a "task approach" [5], which also offers a novel perspective on labor markets undergoing transition and aggregate restructuring. Distinguishing between tasks—non-routine cognitive analytical, non-routine cognitive interpersonal, routine cognitive, routine-manual, non-routine manual-physical—can provide better insights into the specificity of occupations and jobs in particular sectors than the traditional divisions into low-, medium- and highly-skilled jobs, which are generally based on levels of education. The task approach can improve our understanding of how structural change affects jobs in transition. It also allows verification of whether the challenges of job polarization are present in emerging economies. A gradual shift from low-skilled to medium-skilled jobs, especially in manufacturing, constitutes a crucial component of progress. Halting this process at the middle-income level can hinder further convergence, productivity, and wage growth. The CEE region offers interesting lessons in both aspects.
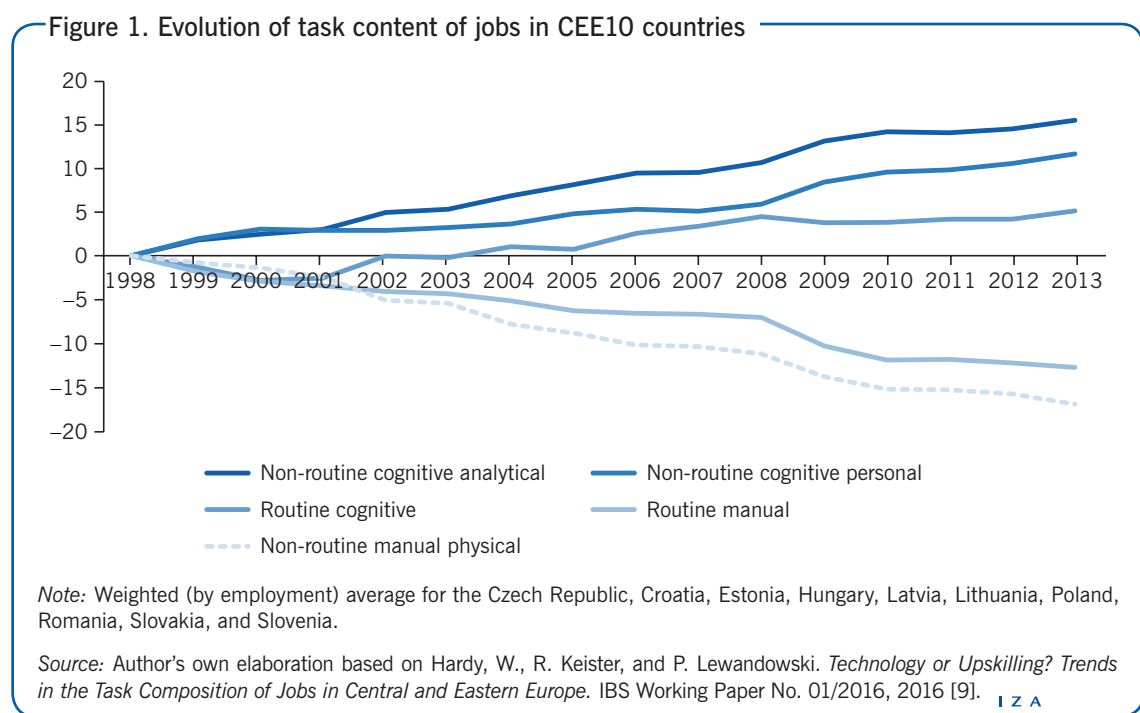
Task content of jobs in Central and Eastern Europe

Studies show that since the mid-1990s, non-routine cognitive tasks have become more abundant in CEE labor markets. This trend was quite consistent across the region. CEE economies also saw manual tasks steadily falling, in line with the skill-biased technological change hypothesis. This pattern was identified in the ten CEE countries that joined the EU between 2004 and 2013 [9], and again, in a separate study, in Poland and six other emerging economies around the world (Brazil, Chile, Costa Rica, India, Sri Lanka, and Turkey) [10]. Similar changes were identified in the former Commonwealth of Independent States and other CEE countries [11]. In most cases, the rise of cognitive work at the expense

of manual work was stronger among younger workers (born after 1974) than among older workers [11].

However, contrary to the US or Western Europe, routine cognitive tasks did not decline in CEE. Figure 1 shows that the average routine cognitive content of jobs in the CEE10 (the Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) actually grew between the late 1990s and early 2010s. It declined only in Hungary and Slovenia; while in the Baltic States and Romania it increased the most [9]. The growth of routine cognitive tasks was also apparent in other emerging countries around the world (most noticeably in Brazil), with the exception of Chile [10].

All these studies of changes over time use the standard approach of combining O*NET data with country-specific labor force survey data. Other studies use instead the OECD Program for the International Assessment of Adult Competencies (PIAAC) Survey of Skills data. While these studies can only show a static picture, as time-series data is currently unavailable, they are able to account for the diversity of tasks within occupations. Moreover, they can analyze the degree of influence that workers have on how they perform their jobs, and how often workers plan their own activities or organize their own time—routine jobs are characterized by low scores in these aspects [12]. This alternative approach confirms the high importance of the routine content of jobs in CEE post-transition economies. All CEE countries, except the Czech Republic and Estonia, exhibited a higher average share of highly routine jobs in manufacturing in 2000, 2005, and 2008–2011, than the OECD average [12]. In services, this was true for medium-routine jobs. Another study based on PIAAC data classified Poland, the Russian Federation, and Slovakia (together with Spain, Italy, and France) as countries with high relative importance of routine cognitive work, and the Czech Republic as one of countries with medium importance of routine cognitive work [13]. Clearly, the movement out of routine cognitive work, which is visible in the majority of advanced economies since the 1980s because of automation and off-shoring, is not yet present in post-transition economies.

Figure 1. Evolution of task content of jobs in CEE10 countries

Legend:
— Non-routine cognitive analytical — Non-routine cognitive personal
— Routine cognitive — Routine manual
--- Non-routine manual physical

Note: Weighted (by employment) average for the Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

Source: Author's own elaboration based on Hardy, W., R. Keister, and P. Lewandowski. *Technology or Upskilling? Trends in the Task Composition of Jobs in Central and Eastern Europe.* IBS Working Paper No. 01/2016, 2016 [9].

Demand-side factors—Structural change

Structural change was an important driver of the evolution of task content structure in CEE. The illustration on page 1 shows that the contribution of between-sector effects—task content changes that would have happened if sectoral employment structures had evolved as they did, but if no educational nor occupational changes had occurred within sectors—exceeded 50% of all observed task changes, except for non-routine cognitive interpersonal tasks [1]. Structural change was the main factor behind the increasing intensity of routine cognitive tasks, and the crucial driver of the decreasing intensity of manual tasks. This in turn can be assigned to the medium-term, steady trend of falling employment in agriculture, which is a sector heavily based on manual work. The substantial contribution of aggregate restructuring to changes in routine cognitive tasks forms the other side of the coin. The stronger the decline in agricultural employment, the larger the between-sector effect, and the larger the routine cognitive task growth. Accordingly, gross reallocation from agriculture to other sectors translated into increasing cognitive demands of an average job in CEE.

A smaller, albeit noticeable, role in the reduction of the manual content of jobs was played by de-industrialization and the moderate decrease in manufacturing employment in CEE. De-agrarianization and deindustrialization were compensated by rising employment in services, which is a sector, to a larger extent, based on cognitive work, in particular the routine cognitive work. On balance, these sectoral shifts have contributed significantly to the growth of routine cognitive work in CEE.

Aggregate restructuring also contributed substantially to the growth in non-routine cognitive analytical tasks, mainly because of the increasing share of services employing highly-skilled workers. Sectoral shifts were much less important for non-routine cognitive personal tasks—for these tasks the within-sector changes were key, especially in countries with the largest improvements on that front, that is, the Baltic states, Poland, and Slovenia. Altogether, the task-content developments in CEE were driven by structural changes, albeit reinforced by other factors.

Supply-side factors—Workforce upskilling

In parallel to aggregate restructuring, the CEE countries recorded substantial workforce upskilling. In 1998, the share of workers with tertiary education, as per the International Standard Classification of Education (ISCED), levels 5–8 (i.e. with college, university, or doctoral degrees) in ten CEE countries averaged 17%, and the share of workers with primary education (ISCED 0–2) amounted to 18%. In 2013, these shares stood at 28% and 10% respectively, which indicates a clear increase in tertiary education. At the same time, the share of workers with secondary education (ISCED 3–4) declined, but only slightly, from 66% to 62%. Workforce upskilling was quite uniform across economic sectors. For example, in Poland all sectors became more saturated with graduates and, on average, reported more than a three-fold increase in the number of tertiary-educated workers. Workforce upskilling was largely driven by the rising tertiary attainment of successive cohorts of labor market entrants, whereas the prevalence of adult education remained limited. Hence, countries that improved the tertiary attainment of young people the most recorded the largest increases in the workforce shares of tertiary graduates.

This had important consequences for the type of labor skills supplied and how they reacted with structural change. In CEE, workers with tertiary education were concentrated in jobs

with above-median content of non-routine cognitive analytical tasks, and below-median content of routine cognitive or manual tasks. The opposite was true for workers with primary education. However, workers with secondary education—who constituted almost two-thirds of all workers in CEE—were almost evenly scattered across the distribution of these tasks. Some of them had occupations with high routine cognitive content, and some of them had occupations with low routine cognitive content (Figure 2). As a result, restructuring and labor demand shifts biased for or against routine cognitive work impacted various secondary educated workers differently, regardless of their identical education level.

Workforce upskilling was a powerful force behind the task content changes in CEE. A shift-share decomposition shown in the illustration on page 1 indicates that its contribution (the between-education effect) to the growth of non-routine cognitive tasks exceeded the magnitude of total observed changes across the region between the late 1990s and early 2010s [1]. The same applies to the decline of manual tasks, which were compressed by both workforce upskilling and gross reallocation of workers from agriculture to services. From the point of view of non-routine cognitive work and manual work, educational change and structural change aligned well, and both factors pushed changes in the same direction. It was different, however, for routine cognitive tasks; in this case, structural change increased demand for such work, but workforce upskilling reduced its supply. Routine cognitive tasks rose across the region, but less than would presumably have happened without educational change.

Empirical studies confirm these conclusions on correlations between workforce skills and task structures. One study used fixed-effects panel models for ten CEE countries in the period 1998–2013 to estimate the relationship between the task content intensities, the educational structure of the workforce, and research and development (R&D) spending, which is a proxy for technology adoption [9]. Based on the estimated regression coefficients, this study attributed over 80% of the total growth in non-routine cognitive tasks (on average across the CEE) to the rising share of tertiary graduates. A similar result

Figure 2. Distribution of workers with respect to the task content of jobs, 1998 (in %)

Below median of a given task			
	Tertiary educated	Secondary educated	Primary educated
Non-routine cognitive analytical	4	53	88
Routine cognitive	80	42	65
Routine manual	94	53	43
Above median of a given task			
	Tertiary educated	Secondary educated	Primary educated
Non-routine cognitive analytical	96	47	12
Routine cognitive	20	58	35
Routine manual	6	47	57

Note: Weighted (by employment) average for Croatia, the Czech Republic, Estonia, Hungary, Latvia, Poland, Slovenia, and Slovakia. Data for Croatia are for 2003. Romania and Lithuania excluded due to data issues.

Source: Keister, R., and P. Lewandowski. *A Routine Transition? Causes and Consequences of the Changing Content of Jobs in Central and Eastern Europe*. IBS Policy Paper 05/2016, 2016 [1].

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was found for declining manual tasks. On the other hand, there was no statistically significant relationship between routine cognitive task intensities and the considered covariates [9]. A study using data produced by PIAAC to analyze manufacturing and services employment in the OECD countries, including CEE, found that higher skills were associated with higher employment in non-routine and low-routine-intensive occupations [12]. This was reflected in lower employment in routine-intensive jobs within sectors. Jointly, these studies suggest that workforce upskilling was related to a decline in routine jobs within sectors, while at the macro-economy level it was the evolution of sectoral structure that was crucial for the evolution of routine cognitive work in CEE.

Higher intensity of routine work in CEE countries is also partly related to lower technology penetration and lower ICT use than in the most advanced economies. One study estimated that differences in ICT use at work accounted for at least 6% of the differences in the relative importance of routine cognitive work across countries, even if the differences in individual characteristics and skills are controlled for [13]. It also showed that CEE countries exhibit both below-average ICT use and above-average relative importance of routine cognitive work. In addition, studies found that technology adoption, proxied by R&D spending [9], and by ICT intensity of industries [12], complements workforce upskilling, and that a positive relationship emerges between technology adoption measures and non-routine cognitive work, while a negative relationship emerges between technology and routine work, especially manual.

Deindustrialization was an important factor behind the hollowing out of middle-skilled, middle-paid jobs in Western European countries in the 1970s–1980s. In these countries, the expansion of services increased the number of jobs at the opposite ends of both the skill and the wage distribution, and contributed to the decline of routine-intensive jobs. In CEE, structural change accelerated following the transition and coincided with ICT expansion, which is also found to contribute to the declining routine cognitive content of jobs. However, in CEE structural change involved a reduction of agricultural, largely manual employment, while deindustrialization was shallow. This pattern of aggregate restructuring reduced the manual content of jobs and increased the cognitive content, especially the routine cognitive content. A parallel workforce upskilling allowed the non-routine cognitive content of jobs to grow, and limited the rise of routine cognitive work. Nevertheless, the intensity of routine cognitive tasks has risen since the late 1990s, to the extent that in the early 2010s, 33% of workers in CEE countries had a highly routine job—leaving them potentially vulnerable to future technical progress [1].

LIMITATIONS AND GAPS

Despite the attention paid by researchers, policymakers, and the media to the impact of modern technology on labor markets, data needed to study the requirements of particular occupations around the world remain scarce. The US O*NET database is the most reliable data source today and most often used in studies on low- and middle-income countries [1], [9], [10], [11]. Such studies assume that the contents of particular occupations around the world are the same as in the US. This is a strong assumption, although it has been shown that the US occupation-based and non-US skill-survey-based measures lead to very similar outcomes for European countries [12]. Furthermore, it is methodologically valid to use O*NET data to construct occupational measures in Europe [9]. Nevertheless, country-specific surveys are needed, especially in low- and middle-income countries, to

quantify the actual content of occupations as well as the skill requirement and routine vs non-routine job content differences between countries.

SUMMARY AND POLICY ADVICE

Since the 1990s, the transition economies of CEE have experienced a decline in agricultural employment and a growth in services and modernization of branch structure within manufacturing and services, which has reshaped the nature of work in these countries. Manual work shrank while cognitive work expanded. Labor supply-side changes in CEE aligned well with restructuring and the expansion of tertiary education fueled the growth of non-routine cognitive content of jobs, similarly to the most advanced economies. Workforce upskilling aligned with the structurally driven shift from low- to middle-skilled jobs and because of the dominant job upgrading, no job polarization occurred. The CEE experience suggests that other emerging economies should invest in education expansion when undergoing structural change to achieve a shift from manual to cognitive work and to support the emergence of highly-skilled jobs.

However, contrary to the US and Western Europe, the routine cognitive content of jobs increased in many CEE countries and also rose among tertiary graduates. This leaves the CEE countries vulnerable to RBTC and technology-driven worker displacement in the future. Policy in transition economies should therefore support further workforce upskilling and the expansion of ICT skills in order to protect its workforce.

Acknowledgments

Competing interests

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Further reading

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